CHARACTERIZATION OF SELECTED LIQUID AND SOLID WASTE EFFLUENTS AT THE ORGDP

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UNION CARBIDE

OAK RIDGE GASEOUS DIFFUSION PLANT
OAK RIDGE, TENNESSEE

prepared for the **U.S. DEPARTMENT OF ENERGY** *under*
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Sponsor: L. J. Peacock

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The following is a presentation of the data which has been accumulated on the samples of various waste effluents at the ORGDP. The information was gathered to provide characterizations of the liquid and solid wastes to be addressed by the Control of Water Pollution, Phase 2, and the Solid Waste Disposal Facilities, 1981 Line Items. These characterizations identify sources within the waste streams which may cause special handling problems with treatment chosen and provide an excellent reference of the multiple effluent streams at the ORGDP.

SOLIDS

Samples were taken at various locations of the K-1407-C Pond, as indicated on the accompanying sketch. Sample IV was the bottom foot of the pond sludge.

The data on the K-1407-C sludges (which appears on Tables 1 and 2) indicates that the solids content and pH are high. Tables 3 and 4 contain data for sludges from K-1401 and selected sludges from other facilities at the ORGDP. The particle size distributions are also included for all of the sludge samples as reference for equipment specifications. Distributions of the samples from K-1407-C Pond are represented on the same graph. These sludges will be handled by the same equipment. Looking at the zeta potential data from Table 2, the possibility exists of blending the sludges from each end of the pond to obtain zero zeta potential for best sludge flocculation.

In addition to the data which is presented here, viscosity measurements were taken of the K-1407-C sludges. Sample I behaves as a dilatant, i.e., the viscosity increases with increasing rate of shear. Sample II's rheological behavior indicates that the viscosity increases as a higher shear rate is applied. To move the sludge at this point, a screw pump (must be a pump without check valves) could be used. The sludge cannot be moved too slowly or too swiftly without undue energy expenditures. The viscosity data observed of the Sample III sludge indicates that it is thixotropic. The viscosity shows a limited decrease with time under a suddenly applied constant stress. A rigorous mathematical method of translating viscosity versus shear stress and shear rate is available for pump selection and pipe sizing.

Preliminary evaluation of the sludge characteristics indicate that pilot work must be required to determine whether the sludge can be concrete fixed as is. Dewatering equipment requirements would be stringent, requiring

further study should dewatering be required. Pilot plant evaluation of the fixation project is being planned.

Liquid streams associated with the solids waste disposal, either as decanted pond water or equipment rinse water, will be handled as a liquid waste source. This stream could be routed through neutralization steps, such as K-1401 wastes, or routed to the sanitary treatment plant, depending on the stream characteristics such as pH and BOD. This disposal evaluation can be done in conjunction with the solid disposal work.

LIQUID EFFLUENTS

The data for the liquid waste streams appears in Table 5. Of special interest is the concentration of the metal ions which are present in high levels. Ion exchange development work will be conducted to ensure the removal of these compounds from the liquid effluents; also, pilot plant studies will be conducted on the clarification and solids settling of these streams.

Liquid samples from K-1413, K-1501, K-1401, and K-1301 have been submitted for complete chamical analyses. As the research continues, additional solid and liquid samples will be analyzed. The accumulated data will be amassed in a supplemental report which will be made available with all alacrity.

TABLE 1

CHEMICAL ANALYSES OF HOMOGENIZED SLUDGES
FROM K-1407-C POND

Analysis Performed	Sample Location - K-1407-C Pond					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
pH	12.32	12.32	12.29	12.29	11.01	7.36
Solids, %	16.24	29.46	27.69	26.51	7.24	3.44
Calcium, %	48.88	43.11	42.29	43.31	27.81	21.04
Sulfates, %	0.78	1.33	1.13	1.70	1.13	0.64
Phosphates, %	0.11	0.08	0.14	0.09	0.18	0.16
Chlorides, %	0.47	0.13	0.23	0.12	0.58	0.54
Uranium, µg/ml	17.1	26.3	196.0	24.2	98.5	384.0
Total Fluoride, %	33.9	28.0	25.1	11.1	15.1	3.9
Spectrochemical						
Aluminum, %	0.31	0.52	0.68	0.35	2.33	2.45
Lead, ppm	63	28	30	24	32	39
Manganese, ppm	33	36	51	34	145	262
Potassium, ppm	549	368	493	122	2530	3400
Cadmium, ppm	< 5	< 5	< 5	< 5	< 5	< 5
Chromium, ppm	25	27	51	24	30	31
Copper, ppm	74	68	74	64	55	43
Nickel, ppm	163	268	286	140	172	251
Zinc, ppm	59	72	62	47	58	55
Particle Size						
Mean, µ	40	36	37	28	22	28
Standard Deviation	1.337	1.432	1.483	1.430	1.208	1.278

TABLE 2

PHYSICAL ANALYSES OF K-1407-C POND SLUDGE

Analysis Performed	Sample Location - K-1407-C Pond			
	I	II	III	IV
Conductivity, micromhos	1.06×10^2	1.04×10^2	2.78×10^2	2.60×10^2
Specific Gravity	1.2571	1.2563	1.1315	1.3800
Specific Gravity of Mother Liquor After Centrifugation	0.99491	1.0025	1.0029	0.9857
Specific Gravity of Solids After Centrifugation	2.77	3.54	3.59	4.33
Suspended Solids				
wt %	31.96	27.60	15.62	36.80
g/l	401.77	346.76	176.72	507.83
Dissolved Solids				
wt %	0.554	0.595	0.155	0.178
g/l	6.961	7.490	1.751	2.456
Zeta Potential, mV	+ 18	+ 25	- 13.5	- 32

TABLE 3

CATION CONCENTRATIONS OF K-1401 SLUDGES

Analysis Performed	K-1401 Blakely Degreaser Sludge	K-1401 Cold Water Rinse Sludge	K-1401 Hot Water Rinse Sludge	K-1401 Acid Tank Sludge	K-1401 Acid Scrubber Sludge
Solids, %	-	77.55	67.80	53.15	52.00
Uranium					
Total U, wt %	0.34	0.03	0.16	0.05	-
$\frac{\text{U-235}}{\text{U Total}}$, wt %	0.92	1.09	1.05	0.91	-
Spectrochemical					
Aluminum, wt %	2.5	10.0	10.0	5.0	0.02
Calcium, wt %	3.5	0.04	0.01	0.02	-
Chromium, wt %	0.5	6.44	0.79	0.08	-
Copper, wt %	1.0	2.0	0.56	0.24	0.001
Cobalt, wt %	0.05	-	-	-	-
Iron, wt %	> 20	24.0	25.0	7.0	0.1
Magnesium, wt %	0.2	0.2	0.65	0.20	0.001
Manganese, wt %	0.2	0.2	0.65	0.20	0.001
Nickel, wt %	0.5	2.0	1.0	0.3	-
Silicon, wt %	10	0.01	0.13	0.02	0.4
Tin, wt %	0.1	0.03	1.5	0.05	-
Titanium, wt %	-	1.0	1.0	1.0	-
Zinc, wt %	0.1	-	-	-	-
Zirconium, wt %	-	Trace	Trace	Trace	-

TABLE 4

ANALYSES OF SELECTED SLUDGES AT THE ORGDP

Analysis Performed	Sample Location			
	K-1515 Blowdown	K-1407-B	K-1203	K-892
pH	6.62	6.82	7.54	9.83
Solids, %	48.75	47.22	79.54	42.50
Calcium, %	1.70	2.21	12.3	37.1
Uranium, µg/ml	7.12	4520	12.5	-
Total Fluoride, %	0.9	0.3	5.8	-
Spectrochemical				
Aluminum, µg/g	1367	825	2000	3289
Chromium, µg/g	90	523	40	99
Copper, µg/g	65	869	116	140
Lead, µg/g	-	-	23	27
Manganese, µg/g	1494	331	258	208
Nickel, µg/g	78	3260	121	45
Zinc, µg/g	-	-	118	417
Particle Size				
Mean, µ	41	37	-	75
Standard Deviation	1.431	1.318	-	3.051

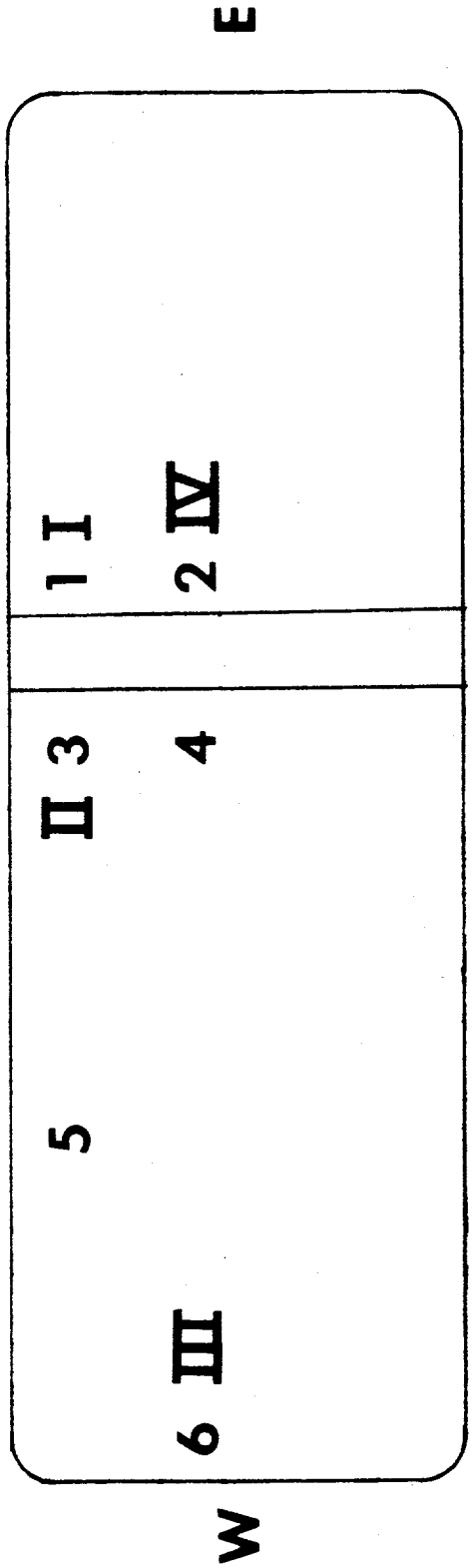
TABLE 5

LIQUID EFFLUENT ANALYSES

Analysis Performed	Sample Location			
	K-1420 Spray Booth	K-1420 Raffinate	K-1420 Condensate	K-1410
pH	6.97	0.08	1.53	7.61
Calcium, ppm	17.4	1.63	0.01	33.2
Uranium, µg/ml	1.16	25.38	0.39	< 0.001
Total Fluoride, %	1.8	0.4	-	-
Spectrochemical				
Aluminum, µg/ml	40	1945	< 0.005	< 0.05
Chromium, µg/ml	0.18	7	0.028	< 0.05
Copper, µg/ml	0.25	15	0.006	< 0.05
Lead, µg/ml	-	-	0.16	0.06
Manganese, µg/ml	16	6	< 0.005	< 0.05
Nickel, µg/ml	23	200	0.005	0.24
Zinc, µg/ml	-	-	0.013	< 0.05

K-1407-C POND

SAMPLE LOCATIONS



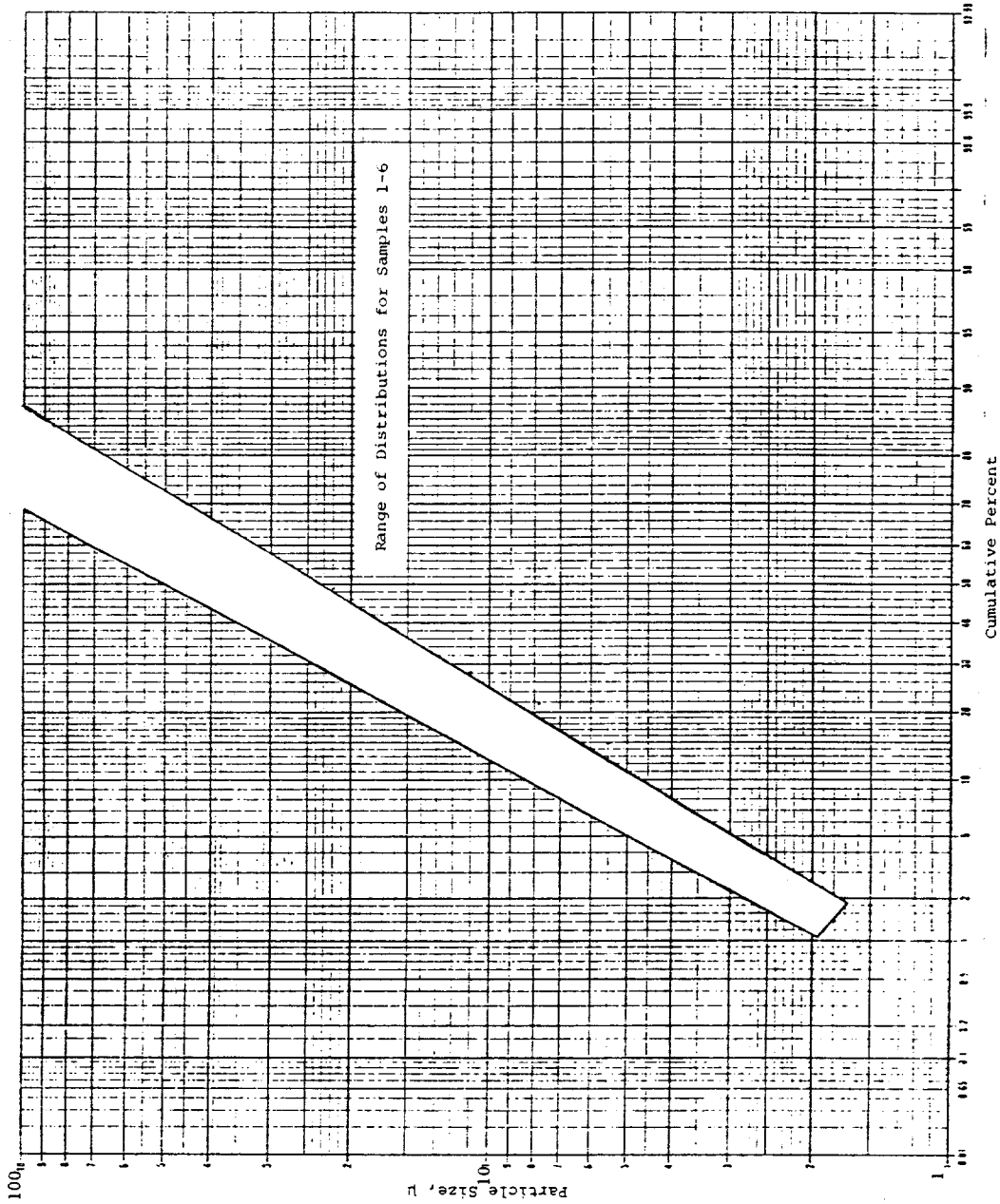


Figure 1

PARTICLE SIZE DISTRIBUTIONS FOR K-1407-C POND SLUDGES

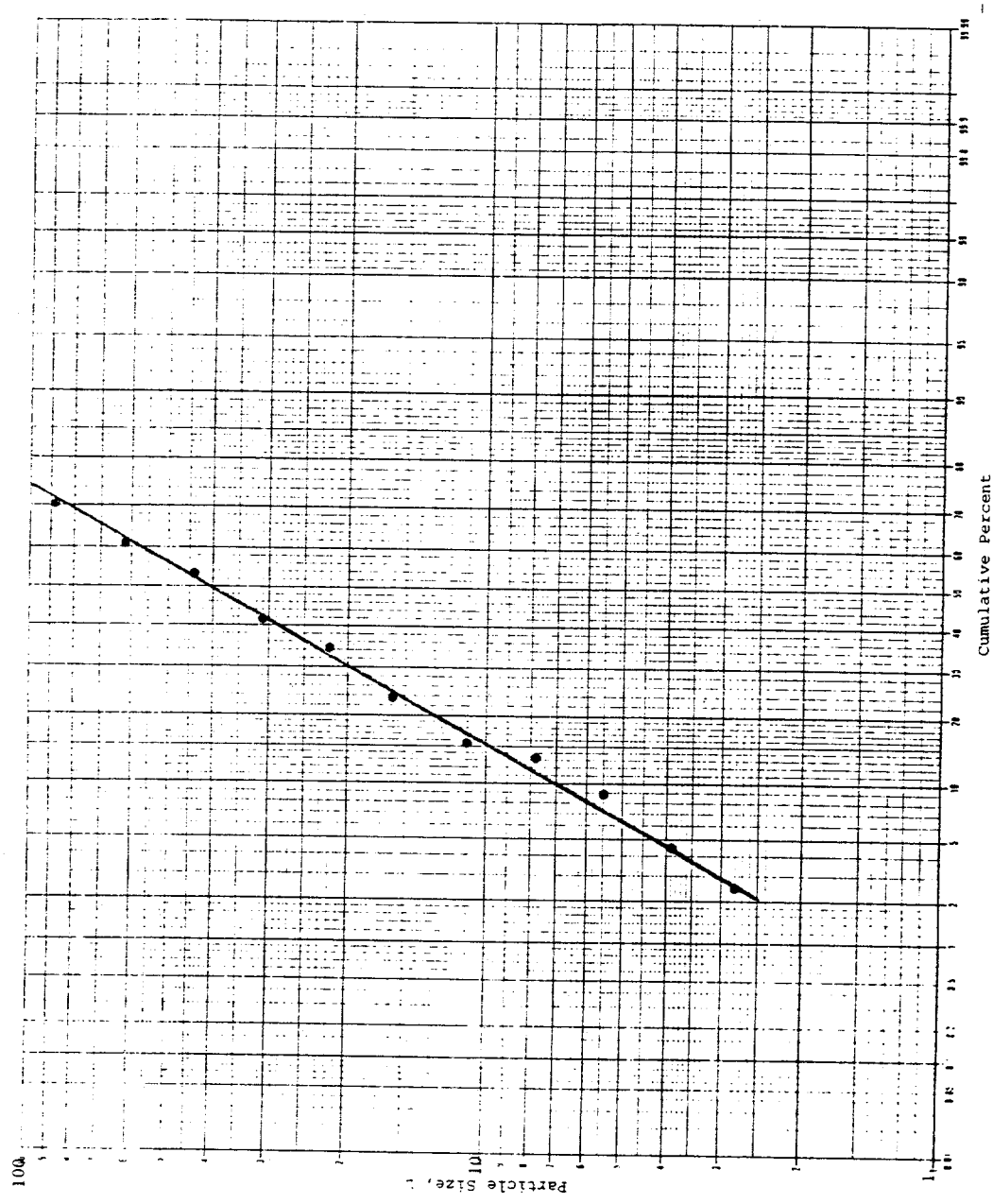


Figure 2

PARTICLE SIZE DISTRIBUTION FOR K-1407-B SLUDGE

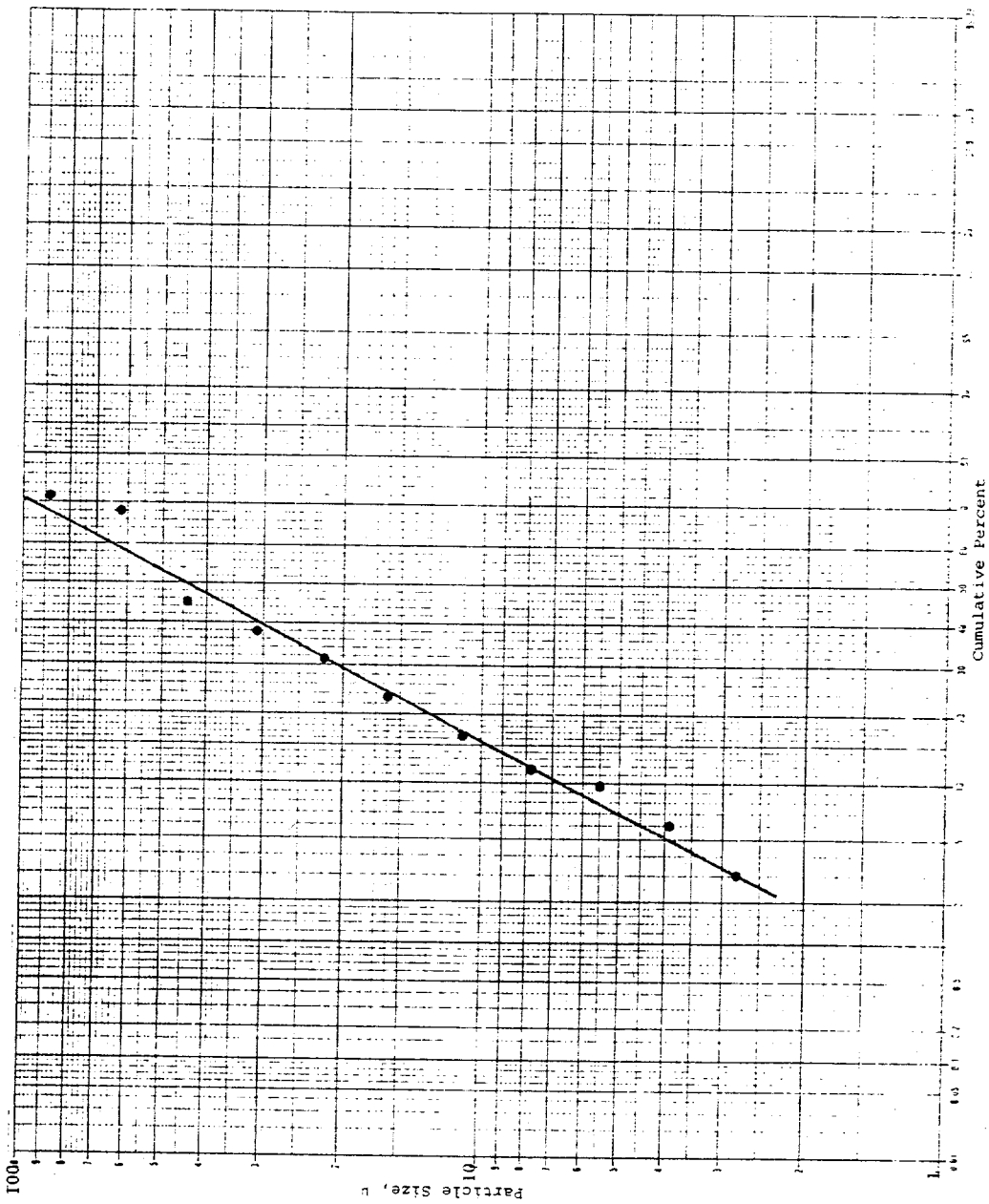


Figure 3

PARTICLE SIZE DISTRIBUTION FOR K-1515 BLOWDOWN SLUDGE

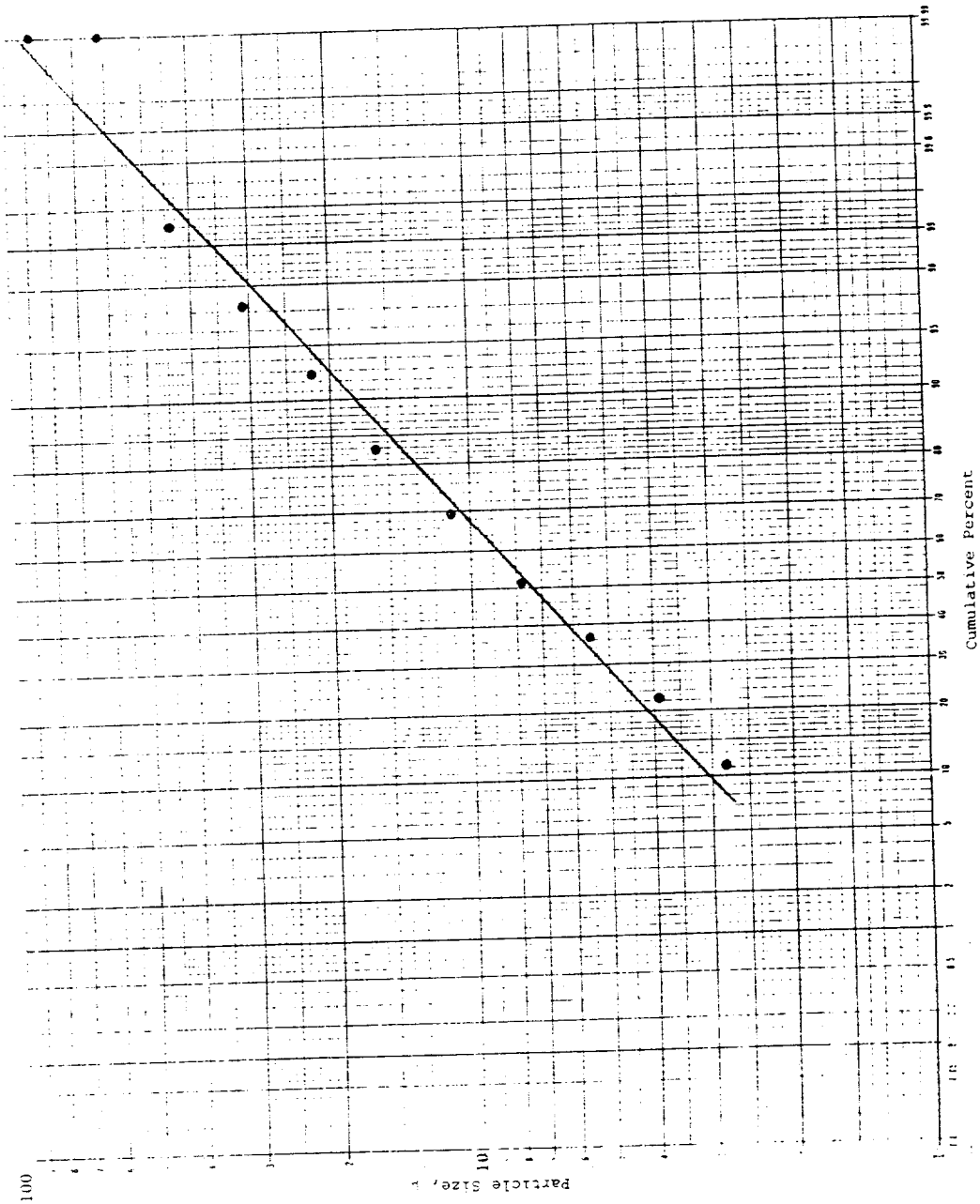


Figure 4

PARTICLE SIZE DISTRIBUTION FOR K-892 SLUDGE

Distribution

Anderson, R. W.
Haberkost, D. C.
Jones, C. G.
McGinnis, C. P.
Merriman, J. R.
Mitchell, M. E.
Orrin, R. C., Sr.
Stinton, L. H.
Thompson, W. T.
Tompkins, R. M.
Wolfe, J. M., Jr.
Plant Records (RC)